

# Striving for Perfection in Production

## Government Bureau of Standards Helps Industry to Solve Problems That Are of Great Concern to Mankind

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**D**ESCRIBING in detail the various scientific and technical problems in which the Bureau of Standards at Washington is engaged would be so vast an undertaking it would lead to a discussion of about every related subject brought to the attention of mankind in the course of the world's progress.

Although many of these problems are highly technical and frequently experimental, there are other problems of very practical and intimate nature whose solution is of the very greatest importance to the public. A better acquaintance on the part of the public of the work involved is therefore desirable.

The subject of standardization in its broad and modern sense involves functions that relate to our general well-being, and concerns more or less directly countless articles and objects that are used by or are of use to every man, woman and child in the country.

Mentioning only a few articles, such as shoe leather—soles and uppers—collapsible tin tubes, sterling silverware, paper, woollens and cotton, satins, baseballs, glues and pastes, printing and writing inks, carbon papers, paints and enamels, optical glass, sirups, incandescent lamps, steel, celluloid, glass, building materials of all kinds, fireproofing and waterproofing, rubber and rubber tires, canning jar rings, spark plugs, motor truck wheels, storage batteries and dry cells, gears, saw blades, knitting needles, oils and dyes, it will be seen that the list is quite diversified. Investigations of electrolysis, radio engineering, building materials tests, acoustic properties of building materials, to say nothing of special military and scientific investigations for the public defense, are constantly being undertaken. But while this work is confined almost exclusively to government needs, the results of the investigations are even more important to the general public and the information is distributed in the form of suitable publications.

### Serves as a Testing Bureau

**T**HE Bureau of Standards, serving as a testing bureau for the various departments of the government when called on, as such, is assisting to place Federal purchases on an economical and businesslike basis. The example of the government in such matters has a far greater influence on the public than is generally supposed. The government can do no greater service to the country than to place its own purchases on a basis which may be taken as a standard by the public at large.

Generally this work is to ascertain whether miscellaneous materials when delivered comply with the specifications. This is especially important since such materials are purchased by means of competitive bids, a method resulting in much fraud and injustice unless suitable standards are established and successful bidders held absolutely to this standard in making deliveries.

The standards with which the bureau is authorized to deal may be conveniently classed as standards of measurement, standard value of constants, standards of quality, standards of mechanical performance, and standards of practice. Behind each standard there is a purpose worth understanding and worth remembering.

A sketch of the problems involved reveals at once that the bureau studies about everything that can be of use, and that it is brought home to us, in dollars and cents generally, and in comfort or ease of mind in other instances.

The scientific and technical staff is organized according to the nature of the expert service involved rather than on the class of standards. In the case of the more important technical fields, divisions have been formed dealing more specifically with large and important classes of materials, but many of the purely scientific questions would be handled by respective scientific divisions or jointly with them.

### Some of the Problems

**T**HERE are nine such divisions.

The one dealing with weights and measures—probably the subject with which the public is most familiar—deals with length, area, volume, mass, density, pressure and time, including researches on units and standards, measuring methods and instruments, specifications and tolerances, and the standardization incident thereto for inspectors of weights and measures, manufacturers of measuring appliances, scientific and technical laboratories, government bureaus, engineers and the general public.

**Electricity:** Electromotive force, resistance, current, inductance, capacity, conductivity, insulation, magnetic permeability and hysteresis, radio activity and radio communication, including researches on electrical units and standards, measuring instruments and methods of measurements; co-operation with standardizing committees of technical societies, with testing laboratories, the electrical industries, public service companies, public utility commissions, municipalities and engineers on problems of standardization, including standards of adequacy and safety of service.

**Heat and Thermometry:** Establishment of the standard scales of temperature throughout the range of measurable temperatures; testing and standardization of thermometers, pyrometers and other temperature-measuring instruments; determination of specific and latent heats, heats of reaction, melting and freezing points, and other properties of materials in the

determination of which precise heat temperature measurements are the principal requirements; standardization of calorimeters; production and distribution of standard heat and temperature samples; industrial applications of heat and temperature measurements; determination of fundamental engineering data involving thermal constants; determination of the fire-resistive properties of structural materials; investigations relating to automotive power plants, fuels and lubricants.

**Light and Optical Instruments:** Spectral analyses; measurement of standard wave lengths; aerial photography; standards and testing of sugar and other materials by optical means; general polarimetry; color measurement and specification of color standards; spectral transmission and reflection of dyes and other materials; design and testing of optical instruments; testing of optical glass; radiometry; investigation of dispersions; interferometry.

**Chemistry:** Chemical composition and purity of materials; chemical properties and constants, including researches on methods of analysis, specifications for technical materials, and preparation of pure materials for standardization work for the government and for industrial and scientific laboratories.

**Engineering Research and Testing:** Operative efficiency of mechanical appliances, accuracy of engineering instruments, conditions affecting their effective use, for example, structure and design as related to durability and efficiency; methods of standardization and tests, standards of performance and fundamental researches on the scientific principles involved in speedometers, pressure gauges, water current meters, anemometers, tachometers, gasoline and other motors, propellers and other airplane parts and materials, and so on.

**Structure, Miscellaneous and Engineering Materials:** Investigation of properties, use, fabrication and design of structural, miscellaneous, and engineering materials; development of specifications covering the use of such materials; improvement of processes of manufacture; improving present and developing new methods of testing; development of testing apparatus.

**Metallurgy:** Thermal analysis and structure of metals, heat treatment and its effects on the properties of metals and alloys, including the researches involved in determining the causes of metal failures; cooling and heating curves; the investigation of hardening, annealing, tempering, cementation; the determination of critical ranges; and the preparation of pure metals and alloys.

### Studies Automotive Problems

**CERAMICS:** Development of new uses for clays; replacement of imported by native materials; improvement of quality products; designing and conducting tests for quality; standards of quality; routine tests for government purchases; acting in advisory capacity as to conservation of fuel and transportation for ceramics; acting as clearing house for collection and dissemination of information.

Let us examine a few of the many activities.

An increasing demand on the part of the automotive industry for research in fundamental problems of this industry has developed. This involves the scientific and technical problems related to the design and operation of internal combustion engines and accessories, and the qualities and characteristics of fuel, lubricants, and so on, for use in such engines.

A knowledge of the phenomena which accompany the burning of fuel in engine cylinders is of importance in the design and improvement of such engines. A study of some features of the problem has been in progress for several years. The situation of the country as regards motor fuels is such as to demand greater efficiency and economy in their use. As a part of this program a special research was undertaken to determine what effect of intake manifold temperature and mode of heating on fuel economy and acceleration of typical automobile engines burning commercial gasoline. Results of this research have been made public.

The amount of paper used by the government departments is approximately 50,000 tons annually, and, as it is necessary for this material to be tested to see that it conforms to the specifications under which it was bought, standard methods of testing paper have been developed. This class of work is called routine testing and consists of chemical and physical tests and microanalysis. Paper is tested for bursting, tensile and tearing strength, as well as—in the case of certain papers—for penetration of ink.

Tests have been made to determine the comparative resistance to water of chrome-tanned and bark-tanned upper leather used in making (army) shoes; or the wearing qualities of a number of specimens of satins by means of an abrasion machine recently constructed; or the method of construction, composition, resilience, endurance under wear, and other properties of representative samples of baseballs; or tinned plate intended for export trade for the canning industry but rejected by the purchasers as unsatisfactory; or "non-scatterable" glass—a protective glass, suitable for aviators' goggles and airplane windshields, and so on.

Unusual attention has been, and is, being given to

the investigation of textiles. Textiles is rather a broad term and somewhat hard to define, but in general it may be considered to refer to such manufactured articles as fabrics, hosiery, knit goods, felt goods, cordage, twine, laces, braids and embroideries, which are made from a number of different raw materials, including cotton, wool, silk, flax, hemp, jute, and so on. Tests are made to determine their physical, chemical, microscopic, and esthetic properties, the development of new materials, preparation of specifications, investigation of manufacturing processes, and aid in the establishment of a scientific basis for textile testing.

The subject of electrolysis of underground pipes, cables, and other metal structures is one which has been given more attention in recent years than formerly, but it still does not receive the attention in many quarters that its importance deserves. When one considers the enormous value of the pipe and cable properties buried in the streets of cities and forming in many cases transmission networks between cities throughout the country, and considers further that there are very few water, gas, or lead cable systems which are not more or less subject at some points to electrolysis damage from stray currents, it is possible to form a better judgment of the practical importance of the subject.

### A Billion Dollars in Pipes

**T**HE water and gas pipes systems of this country alone have an aggregate value at the present time in excess of \$1,000,000,000, and, in addition to this, there is a vast extent of underground lead cable systems belonging to telephone and electric power companies and to municipalities. There also are possibilities of trouble in the case of bridge structures, portions of steel-frame buildings, and piers, which are occasionally exposed to damage from this source.

It is not alone the property loss, however, that makes the electrolysis problem one of importance. An important fact is the inconvenience to consumers of water, gas and telephone service due to the interruption of the service when repairs are made necessary by electrolytic damage. Possible interruption of the service of police and fire alarm systems is also one of considerable importance to almost every municipality.

Another important field is the investigation of fire resistive properties of structural materials. The standardization of fire tests is studied; fire tests of structural materials and structures are carried on as well as investigations to develop engineering data relative to the fire resistive features of building construction; tests of fire retarding devices, and investigations of building codes and fire codes. The object of the investigation is to furnish architects, construction engineers, builders, state and city building bureaus, insurance interests and others with fundamental engineering data relating to the behavior and safety of various types of building material and construction when exposed to different conditions met with in fires.

Every process which is improved through the investigations of the scientific staff of the bureau results in conservation. Thus, if the section concerned with the investigation of internal combustion engines can discover a means for rendering automobile engines even ten per cent more efficient on the average than they are today, it will result in a tremendous saving in the amount of gasoline consumed and will lengthen the time during which this fuel is available for our use. Similar arguments apply to improvements in the making of textiles, paper, rubber and in metallurgical work.

### Helps to Improve Quality

**I**T MUST not be inferred that the Bureau of Standards devotes its activities principally to the interests of the user or consumer. The fundamental facts regarding standards of measurement, quality and performance, for instance, are the very things which most deeply concern manufacturers; they are concerned, either directly or indirectly, with the improvement of methods of production or the quality of the output. And it is on quality as well as on price that competition must finally depend, whether in domestic or foreign commerce.

The use of exact methods and scientific results is the greatest factor in the improvement of quality, efficiency, or the development of new industries. The educational value of the bureau's work in this respect is almost entirely unknown to the general public, and yet hundreds of letters are received, as well as many personal visits from interested parties, seeking information that eventually redounds to the public's interest, economic or otherwise.

In conclusion, I wish to state that the bureau does not compete with private testing laboratories, but endeavors to assist them by the development of standard specifications, methods of measurement, and other matters where uniformity is desirable. In fact, the bureau has the hearty co-operation of manufacturers, engineers and technical societies.

The Bureau of Standards is willing to extend the use of its technical facilities to qualified investigators paid by technical societies and industrial organizations. The plan contemplates that such investigators will work on problems of particular interest to the organization concerned.